

CLAIMS

1. An expression vector, comprising a nucleic acid sequence encoding a polypeptide
5 at least 40% identical to SEQ ID NO: 1, wherein said nucleic acid encodes a protein
having monooxygenase P450 activity.
2. The expression vector of Claim 1, wherein the monooxygenase P450 activity is ϵ -
ring hydroxylase activity.
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3. The expression vector of Claim 2, wherein the monooxygenase P450 activity
further comprises β -ring hydroxylase activity.
4. The expression vector of Claim 1, wherein the monooxygenase P450 activity is β -
15 ring hydroxylase activity.
5. The expression vector of Claim 1, wherein said nucleic acid sequence further
encodes a polypeptide comprising a cytochrome P450 molecular oxygen binding pocket
conserved consensus amino acid motif corresponding to SEQ ID NO:12.
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6. The expression vector of Claim 5, wherein said nucleic acid sequence further
encodes a polypeptide comprising a conserved transmembrane domain sequence
corresponding to SEQ ID NO: 10.
- 25 7. The expression vector of Claim 1, wherein said nucleic acid sequence further
encodes a polypeptide comprising a conserved consensus cysteine motif corresponding to
SEQ ID NO:14.
8. The expression vector of Claim 7, wherein said nucleic acid sequence further
30 encodes a polypeptide comprising a conserved N-terminal transit peptide for chloroplast-
targeting corresponding to SEQ ID NO:11.

9. The expression vector of Claim 1, wherein said polypeptide at least 40% identical to SEQ ID NO: 1 is selected from the group consisting of SEQ ID NO: 1-4, 16-21, 33-39, 49-52 and 56.

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10. The expression vector of Claim 1, wherein said nucleic acid sequence is selected from the group consisting of SEQ ID NOs: 5-9, 22-27, 40-48, 53-55, 57 and 58.

11. The expression vector of Claim 1, wherein said vector is a eukaryotic vector.

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12. The expression vector of Claim 11, wherein said eukaryotic vector is a plant vector.

13. The expression vector of Claim 12, wherein said plant vector comprises a T-DNA vector.

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14. The expression vector of Claim 1, wherein said vector is a prokaryotic vector.

15. A nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1 operably linked to an heterologous promoter, wherein said nucleic acid sequence encodes a protein having ϵ - ring hydroxylase activity.

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16. The promoter of Claim 15, wherein said promoter is a eukaryotic promoter.

17. The promoter of Claim 16, wherein said eukaryotic promoter is active in a plant.

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18. An expression vector comprising a first nucleic acid sequence encoding a nucleic acid product that interferes with the expression of a second nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1.

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19. The expression vector of Claim 18, wherein said nucleic acid product that interferes is an antisense sequence.

20. The expression vector of Claim 18, wherein said nucleic acid product that
5 interferes is a dsRNA that mediates RNA interference.

21. A transgenic plant comprising a nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1, wherein said nucleic acid sequence encodes a protein having monooxygenase P450 activity, and wherein said nucleic acid sequence is
10 heterologous to the plant.

22. The transgenic plant of Claim 21, wherein said transgenic plant comprises one or more of the following: *Brassicaceae*, *Poaceae*, *Fabaceae*, *Asteraceae*, *Solanaceae*, and *Volvocaceae*.

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23. The transgenic plant of Claim 22, wherein said transgenic plant is a marigold.

24. The transgenic plant of Claim 21, wherein said transgenic plant is a crop plant.

20 25. A transgenic plant cell comprising a nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1, wherein said nucleic acid sequence encodes a protein having monooxygenase P450 activity, and wherein said nucleic acid sequence is heterologous to the plant cell.

25 26. A transgenic plant seed comprising a nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1, wherein said nucleic acid sequence encodes a protein having monooxygenase P450 activity, and wherein said nucleic acid sequence is heterologous to the plant seed.

27. A transgenic plant comprising a nucleic acid encoding a polypeptide at least 40% identical to SEQ ID NO: 1 operably linked to a promoter, wherein the nucleic acid sequence encodes a protein having ϵ - ring hydroxylase activity.

5 28. A method for altering the phenotype of a plant, comprising:

- a) providing;
 - i) an expression vector comprising a nucleic acid sequence encoding a polypeptide at least 40% identical to SEQ ID NO: 1, and
 - ii) plant tissue; and

10 b) introducing said vector into said plant tissue under conditions such that expression of said nucleic acid sequence alters the phenotype of a plant.

29. A method for altering carotenoid ratios, comprising:

- a) providing a vector construct comprising a nucleic acid encoding a
15 polypeptide at least 40% identical to SEQ ID NO: 1, wherein said nucleic acid sequence encodes a protein having ϵ - ring hydroxylase activity; and
- b) producing a plant comprising the vector, wherein said plant exhibits altered carotenoid ratios.

20 30. A method for altering the carotenoid production of a plant, comprising:

- a) providing;
 - i) an expression vector comprising a nucleic acid encoding a
polypeptide at least 40% identical to SEQ ID NO: 1, wherein the nucleic
acid sequence encodes a protein having ϵ - ring hydroxylase activity, and
 - ii) plant tissue; and

25 b) introducing said vector into said plant tissue under conditions such that the protein encoded by the nucleic acid sequence is expressed so that the plant tissue exhibits altered carotenoid ratios.

30 31. A method for producing lutein, comprising:

a) providing a transgenic host cell comprising a heterologous nucleic acid sequence, wherein the heterologous nucleic acid sequence encodes a polypeptide at least 40% identical to SEQ ID NO: 1, under conditions sufficient for expression of the encoded protein; and

5 b) culturing said transgenic host cell under conditions such that lutein is produced.

32. A method for altering carotenoid production in a plant, comprising:

a) providing a transgenic plant comprising a heterologous nucleic acid
10 sequence, wherein said heterologous nucleic acid sequence encodes a polypeptide at least 40% identical to SEQ ID NO: 1,

b) cultivating said transgenic plant under conditions sufficient for increasing non-hydroxylated carotenes in the plant tissue.